What is claimed is:

1. A composition comprising:

a compound; and

a semiconductor nanocrystal associated with the compound, the nanocrystal having a characteristic spectral emission, wherein said spectral emission is tunable to a desired wavelength by controlling the size of the nanocrystal, and wherein said emission provides information about a biological state or event.

2. The composition of claim 1, wherein the nanocrystal further comprises:

a layer overcoating ~~the quantum dot~~ the semiconductor nanocrystal, the layer being comprised of a material having a band gap greater than that of the quantum dot.

3. The composition of claim 1, wherein the said compound has an affinity for a biological target.

4. The composition of claim 3, wherein the affinity is a specific affinity.

5. The composition of claim 1, wherein the biological state for which information is provided is selected from the group consisting of: quantitative and qualitative presence of a biological moiety; structure, composition, and conformation of a biological moiety; and localization of a biological moiety in an environment.

6. The composition of claim 1, wherein the biological event for which information is provided is selected from the group consisting of: interactions of biological moieties, alterations in structures of biological compounds, and alterations in biological processes.

7. The composition of claim 1, wherein the association of the compound to the nanocrystal is accomplished through an assoication selected from the group consisting

of covalent, noncovalent, hydrophobic, hydrophilic, electrostatic, magnetic or coordination through a metal complex.

8. The composition of claim 1, wherein the association of the compound to the nanocrystal is accomplished through a bridging ligand, said ligand having a first end linked to the nanocrystal and a second end coupled to the compound.

9. The composition of claim 4, wherein the affinity of the compound to the biological target is due to a noncovalent, hydrophobic, hydrophilic, electrostatic, van der Waals, hydrogen bonding, or magnetic attraction.

10. The composition of claim 1 or 2, wherein compound is a biological compound.

11. The composition of claim 10, wherein the compound is a biological compound selected from the group consisting of: proteins, peptides, nucleic acids, carbohydrates, cells, lipids, cellular organelles, signaling molecules,.

12. The composition of claim 10, wherein the compound comprises a peptide.

13. The composition of claim 10, wherein the compound comprises a protein.

14. The composition of claim 13, wherein the protein comprises an antibody.

15. The composition of claim 14, wherein the antibody comprises a polyclonal or a monoclonal antibody.

16. The composition of claim 13, wherein the protein comprises avidin or streptavidin.

17. The composition of claim 10, wherein the biological compound comprises a nucleic acid.

18. The composition of claim 17, wherein the biological compound comprises a an oligonucleotide.

19. The composition of claim 18, wherein the oligonucleotide is at least approximately 20-30 nucleotides long.

20. The composition of claim 17, wherein the biological compound is selected from the group consisting of: ribonucleotides, deoxyribonucleotides, dideoxyribonucleotides and derivatives thereof.

21. The composition of claim 17 wherein the biological compound is selected from the group consisting of; single stranded nucleic acid, double stranded nucleic acids, and triple stranded nucleic acid clusters, Holliday junctions, circular single-stranded DNA, circular double-stranded DNA, and DNA cubes.

22. The composition of claim 1, wherein the compound comprises a small molecule.

23. The composition of claim 1, wherein the small molecule is biotin.

24. The composition of claim 23, wherein the small molecule is an enzyme inhibitor.

25. The composition of claim 1, wherein the compound is associated with the nanocrystal through a briding biotin:avidin complex.

26. The composition of claim 1, wherein the compound is associated with the nanocrystal through a bridging biotin:streptavidin complex.

27. The composition of claim 1, wherein the nanocrystal is water-soluble.

28. The composition of claim 1, wherein the nanocrystal is a member of a ~~substantially~~ monodisperse particle population.

29. The composition of claim 27, wherein the water-soluble nanocrystal comprises:

a quantum dot having a selected band gap energy;

a layer overcoating the quantum dot, the overcoating layer comprised of a material having a band gap energy greater than that of the quantum dot; and

an outer layer, the layer comprising a ligand having at least one linking group for attachment of the compound to the overcoating layer and at least one hydrophilic group spaced apart from the linking group by a hydrophobic region sufficient to prevent electron charge transfer across the hydrophobic region.

30. The composition of claim 29, wherein the ligand comprises the formula, $H_zX((CH_2)_nCO_2H)_y$ and salts thereof, where X is S, N, P or O=P; $n \geq 6$; and z and y are selected to satisfy the valence requirements of X.

31. The composition of claim 29, wherein the linking group comprises a moiety selected from the group consisting of amines, thiols, phosphines, phosphine oxides, and amine oxides.

32. The composition of claim 29, wherein the hydrophilic group is selected from the group consisting of carboxylic acid, carboxylate ($-CO_2^-$), sulfonate (SO_3^-), hydroxide (-OH), alkoxides, ammonium salts ($-NH_4^+$), and phosphate ($-PO_4^{-2}$ and $-PO_3^{-2}$).

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33. The composition of claim 1, wherein the nanocrystal exhibits less than a 10% rms deviation in diameter of the quantum dot.

34. The composition of claim 1, wherein a plurality of compositions exhibits a spectral range that is less than about 40 nm at full width half maximum (FWHM).

35. The composition of claim 1, wherein a plurality of compositions exhibits a spectral range that is less than about 25 nm at full width half maximum (FWHM).

36. The composition of claim 1, wherein the nanocrystal has a spectral range that is less than about 12-15 nm at full width half maximum (FWHM).

37. The composition of claim 29, wherein the nanocrystal exhibits photoluminescence having quantum yields of greater than 10% in water.

38. The composition of claim 29, wherein the nanocrystal exhibits photoluminescence having quantum yields in the range of about 10-30% in water.

39. The composition of claim 1, wherein the nanocrystal is a Group II-VI, III-V or IV semiconductor.

40. The composition of claim 1, wherein the nanocrystal is a ZnS overcoated CdSe nanocrystal.

41. The composition of claim 1, wherein the nanocrystal has a narrow spectral range selected from the spectrum in the range of about 300 nm to about 1500 nm.

42. The composition of claim 1, wherein the nanocrystal has a core particle size selected from the range of about 12 Å to about 150 Å.

43. The composition of claim 1, wherein the compound is associated with the water soluble nanocrystal by means of covalent attachment.

44. The composition of claim 1, wherein the compound is associated with the water soluble nanocrystal directly through a thiol or an amine group coordinated to the semiconductor nanocrystal.

45. The composition of claim 30, wherein the compound is associated with the nanocrystal by means of covalent coupling of a carboxylic acid moiety with an amine group of the compound.

46. A method of detecting an interaction between a compound and a biological target, comprising steps of:

providing a composition capable of a characteristic spectral emission, the composition comprising a compound; and a semiconductor nanocrystal associated with the compound, wherein said spectral emission is tunable to a desired wavelength by controlling the size of the nanocrystal, and wherein said emission provides information about a biological state or event;

allowing a sample comprising a biological target to interact with the composition; and

detecting interaction between the compound and the biological target by monitoring the spectral emission of the sample.

47. The method of claim 47, wherein the spectral emission is associated with assays selected from the group consisting of: immunochemistry, immunocytochemistry, immunobiology, immunofluorescence, DNA sequence analyses, fluorescence resonance energy transfer, flow cytometry, fluorescence activated cell sorting, diagnotics in biological systems, and high-throughput screening.

48. An apparatus for reading the output of biological substrates encoded with multicolor fluorescent markers.

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